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Factsheet

ZINC REQUIREMENTS FOR FIELD CROPS

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Zinc is one of 16 elements required by all plants for growth and seed production. It is classed as a "micronutrient" because it is required in small amounts.

Some crops are more efficient at removing essential nutrients from the soil, or require less, than other plants. Of all the field crops, corn is the main one showing zinc deficiency in Ontario. White beans may be deficient on rare occasions. Our soils supply sufficient zinc for other common field crops. Among the horticultural crops, snap beans and onions are occasionally zinc deficent in Ontario.

ZINC DEFICIENCY SYMPTOMS

Zinc deficiency usually occurs in patches in a field in the early stages of growth. On corn it appears at the four to six leaf stage of growth as broad whitish stripes on one or both sides of the midrib in the second and third leaf from the top of the plant (Figure 1). Internodes can be shortened giving a stunted appearance. Symptoms occasionally continue to show almost to harvest. If deficiency remains at silking time, it appears as narrow greenish-white stripes on leaves up to the ear (Figure 2).

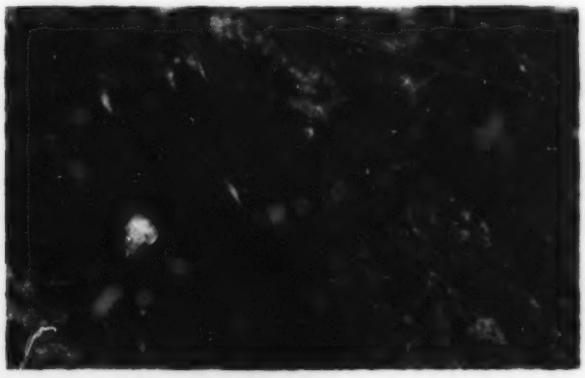

Figure 1. Zinc deficiency in young corn

Figure 2. Zinc deficiency in corn after silking

Zinc deficiency is sometimes confused with magnesium deficiency. Magnesium deficiency begins on the bottom leaves while zinc deficiency appears on the top half or mid section of the plant. Striping between the veins is more uniform along the length and breadth of the leaf with magnesium than with zinc deficiency. With magnesium deficiency the bottom leaves frequently develop a reddish or purple color starting at the tips.

ZINC AVAILABILITY IN SOILS

Zinc is a natural constituent of the rocks and minerals from which soils are formed. Soil organic matter also provides an important source of available zinc in Ontario soils, with deficiencies occurring mainly where erosion has removed the surface soil with its higher

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organic matter content. Normally zinc is considered to be more available in acid soils, but in a sampling of Ontario crops there was no relation between soil pH and the zinc content of plants. Zinc deficiency in corn has appeared on alkaline to slightly acid soils (pH as low as 6.0). **Excellent crops without zinc deficiency, are grown on many Ontario soils with pH values as high as 8.0.**

Zinc deficiency on corn is increased by phosphorus fertilization and by high soil phosphorus levels. It is therefore important not to overfertilize with phosphorus on soils which are low in zinc. The effect of phosphorus on zinc content of corn has been clearly demonstrated in Ontario (Table 1).

METHODS OF MEASURING THE NEED FOR ZINC

At the present time visual deficiency symptoms on the leaves are probably the best guide for annual crops. A zinc soil test has also been useful in predicting zinc deficiency. Analysis of corn leaf tissue at silking has not been a reliable indicator of zinc deficiency results. Corn in one field may show no sign of deficiency and no yield increase from zinc applications at leaf zinc levels that are accompanied by deficiency in another field. Plant analysis has been more dependable on tree fruits.

DOES ZINC FERTILIZATION PAY?

Yield increases due to zinc additions are rare in Ontario and usually confined to small patches within fields. In several cases, no yield response has been obtained with applied zinc even where deficiency has been noted. Trials by Ridgetown College of Agricultural Technology on 17 apparently zinc deficient sites in Ontario gave an average yield increase of 188 kg corn grain/ha. However, on one farm up to 630 kg/ha yield increase was measured over 5 years where zinc was applied. In this case, zinc application was profitable. Response to applied zinc should not be expected unless deficiency symptoms are quite marked. Many of the zinc deficient spots in Southwestern Ontario are on eroded soils low in organic matter with low yield potential compared to adjacent non-eroded soils. Where zinc deficiency occurs on soils high in available phosphorus it is more appropriate in most cases to eliminate the deficiency by omitting phosphorus from the fertilizer program, than to apply zinc as fertilizer.

CORRECTING ZINC DEFICIENCY

Animal manures contain zinc and are believed to increase the availability of soil zinc. Their use can help to prevent deficiency. Most sewage sludges also contain appreciable zinc and moderate applications of these materials may be useful on zinc deficient areas. Where deficiency already is a problem other zinc sources may be required.

Zinc deficiency can be corrected by application of zinc fertilizer, either as a soil application or as a foliar spray. Sprays may be useful to correct a deficiency if it is applied as soon as the symptoms appear. Soil applications have an advantage where they can be applied before or at seeding and hence prevent deficiency. It is possible to apply sufficient zinc to the soil in one application to last for up to five years.

Zinc can be applied to the soil as a single nutrient or in a mixed fertilizer. Where deficiencies are only in patches, the simplest method is probably to spread the zinc fertilizer alone with a propeller type, hand or tractor mounted spreader. Where whole fields are to be treated, it is more common to apply zinc in a blended fertilizer. Granular zinc fertilizers are commonly mixed with granular nitrogen, phosphate and/or potash fertilizers. If the granules are not the same size there is a danger of segregation resulting in uneven application.

Zinc response in Ontario has not been sufficiently large or consistent to permit evaluation of methods of application. In some U.S. tests broadcasting has been superior to banding and in other cases the opposite has been true; differences have not usually been large. Since the deficiency is rarely severe in Ontario either method is probably satisfactory. All soil applications should be incorporated at least to seeding depth.

Table 1. Effect of phosphorus applications on zinc content of corn leaves at silking in 1970.

Phosphate (P_2O_5) applied*	Zinc in leaves - ppm		
kg/ha	Fox sandy loam	Conestoga loam	Oneida clay loam
0	25	27	27
26	22	26	24
52	26	24	22
102	20	22	23
204	19	20	22

**These rates of phosphate were applied for the preceding 4, 4 and 3 years on the Fox sandy loam, Conestoga loam, and Oneida loam respectivley.*

The most commonly available sources of zinc are sulfates, oxides, sulfate-oxide mixtures, chelates and organic complexes such as polyflavinoids and ligosulfonates. Zinc oxides are effective only if finely ground. The chelates and organic complexes may be applied at one-fifth the rate of zinc recommended for sulfates. Even at these lower rates they are usually more expensive. Their residual effect after the first year is no greater than for sulfates. They, therefore, have little residual effect when applied at one-fifth the rate recommended for sulfates. Some zinc fertilizers and their rates of application are presented in Table 2.

Table 2. Zinc fertilizers for soil application*

Fertilizer	% Zn	kg material/kg/Zn	Application Rates kg Zinc/ha
Zinc sulfate	36	2.78	4-12**
Zinc oxide	78-82	1.28-1.22	4-12**
Zinc oxide - sulfate mixtues	28	3.57	4-12**
Zinc-EDTA (Na_2Zn EDTA) Chelate Zinc lignosulfonate Zinc polyflavinoids	7-14	14.3-7.1	0.8-2.5 (1/5 the rate for zinc sulfate)

**For foliar application zinc sulfate is the most common source, a suitable concentration being 0.72 kg zinc/1000 l (0.6 lb. zinc/100 gal.). Sufficient spray should be applied to wet the foliage. A wetting agent should be used and spraying should not be done when plants are wilted. Spray as soon as or before symptoms appear and, for severe deficiences, a second time 3 weeks later. Zinc chelates may be used for spray applications at one-fifth the rate of zinc required for zinc sulfate.*

***The 12 kg/ha rate may be sufficient for 4 to 5 years. Not over 4 kg zinc/ha should be applied in a band at seeding for corn.*

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